QUARTERLY REPORT
NASA CONTRACT NAS5-31368
FOR MODIS TEAM MEMBER STEVEN W. RUNNING
ASSOC. TEAM MEMBER RAMAKRISHNA R. NEMANI
SOFTWARE ENGINEER JOSEPH GLASSY
15 APRIL 1996

Activities of Team Member S.W.Running

Meetings Attended:

January 1996: * IGBP Biospheric Aspects of Hydrologic Cycle, Executive Committee
* NASA VEMAP project meeting

February 1996: * National Center for Ecological Analysis and Synthesis, Board of Directors meeting
* EOS Science Executive Committee meeting

March 1996: * EOS Test Site Meeting
* NASA EOS Hydrology Panel

April 1996: * IGBP 1st Science Congress

* As Chair of the EOS Land Panel, I co-authored and edited Chapter 7, Land Ecosystems and Hydrology of the EOS Science Plan.

Publications:

VEMAP members. 1995. Vegetation/ecosystem modeling and analysis project: comparing biogeography and biogeochemistry models in a contienetal-scale study of terrestrail ecosystem responses to climate change and CO2 doubling. ***Global Biogeochemical Cycles*** **9(4):** 407-437.

Neilson, R.P. and S.W.Running. 1996. Global dynamic vegetation modeling: coupling biogeochemistry and biogeography models. ***Ecological Applications*** (In Press)

Baldocchi, D., Valentini, R., Running, S., Oechel, W., and Dahlman, R. 1996. Strategies for measuring and modeling carbon dioxide and water vapour fluxes over terrestrial ecosystems. ***Global Change Bioloby 2*** (In Press)

Cienciala, E., Running, S.W., Lindroth, A., Grelle, A., Ryan, M.G. 1996. Analysis of carbon and water fluxes from the NOPEX boreal forest: comparison of measurements with FOREST-BGC simulations. ***Journal of Hydrology*** (In Press)

Churkina, G., Running, S.W., Schloss, A.L. 1996. The importance of water availability to primary productivity in global terrestrial models. (Pending submission on the PIK-95 Global NPP Project)

Activities of Associate Team Member R.R. Nemani

Presentations:

MODIS Science:

* Revised and submitted MODIS PSN/NPP algorithm.

* An extensive analysis of the influence of canopy structural/optical properties on spectral reflectance was conducted using a 3-D radiative transfer model. This analysis helped us to identify six vegetation canopies that are significantly different from each other. These are shrubs, grass/cereal crops, broadleaf crops, broadleaf forests, needle forests and savanna.

* A prototype of global land cover classification scheme is developed using red, nir and thermal-ir data to derive the above six classes. The scheme is implemented using AVHRR Pathfinder, 8 km global data.

* A prototype version of our Look-Up-Table for LAI/FPAR was produced for global grasslands. The approach is being extended for other biomes.

* To ensure reliabel estimates from FPAR/LAI algorithm (in cases where LUT searches fail), backup algorithms are being developed based on VI produced from MODIS.

* Global Ecosystem Simulation System was used to compute and map net primary production and heterotrophic respiration at 0.5x0.5 resolution. The results from this analysis are being compared against results from other models and observations.

Publications:

Nemani, R.R., and S.W. Running. 1996. Satellite monitoring of global land cover changes and their impact on climate. Climatic change (in press).

Nemani, R.R., and S.W. Running. 1996. Implementation of a hierarchical global biome classification in biospheric models. Journal of vegetation science (in press).

Nemani, R.R., S.W. Running and R.A. Pielke. 1996. Global vegetation cover changes from coarse resolution satellite data. Journal of Geophysical Research (in press).

Nemani, R.R., and S.W. Running. 1996. Land cover classification using multi-temporal red, nir and thermal-ir AVHRR data. Ecological applications (in press).

Hunt, E.R., Jr., S.C. Piper, R. Nemani, C.D. Keeling, R.D. Otto, and S.W. Running. 1996. Global net carbon exchange and intra-annual atmospheric CO_2 concentrations Predicted by an Ecosystem Process Model and Three-Dimensional Atmospheric Transport Model. (In Press)

ACTIVITIES OF J. M.Glassy, MODIS Software Engineer: October, 1995

Objectives:

1) Highest priority during this period was given to algorithm refinement leading up to a delivery of the MOD15 (FPAR, LAI) source codes as a “Pre-V1" software delivery, and on preparation of the MOD17 codes for a late May, 1996 Pre-V1 delivery. This delivery was successfully made on April 22, 1996, prior to the MODIS Science Team Meeting.

2) Implementation of the FY 1996 component of the MODIS Univ. of Montana SCF (Compute Facility) plan, including initial acquisitions of a RAID 0/3 disk store, a local network services upgrade, and a mid level science/data compute server.

3) A part-time assistant programmer was hired in late January, 1996, and is now contributing to a variety of Univ. Montana SCF software development and science data managment task areas.

Work Accomplished:

1) ***D15 Pre-V1 Software Delivery***: During this period, a Pre-Version 1 generation of the MODIS Land MOD15 (FPAR, LAI) algorithm software was delivered to the MODIS Configuration Manager, Jean Wilkins, of the MODIS SDST organization. Note that the MOD15 algorithm suite now consists of (3) separate software executables; a pre-processor (***laifp3***) to spatially aggregate the MOD09 product reflectance inputs, the main FPAR algorithm (***fparlai***) , and a post-processor (***laicomp***) for temporally compositing the intermediate daily 1 KM outputs into a single product for the composite period. Paul Fisher of the SDST conducted the MODIS and ESDIS SDP standards compliance check using the PR-QA source code compliance software on the SGI modis-xl host at GSFC. The MOD15 codes were successfully compiled and built, and the test suite supplied with the delivery was successfully executed in the

EOSDIS/ESDIS PGS environment on the SGI. The MOD15 test output did vary from the output produced on the SGI at GSFC, and a number of verification tests are currently being conducted to ascertain the reasons for this variance.

2) ***D15 backup (empirical) Algorithm implementation***: Just prior to the MOD15 Pre-V1 software delivery, the latest FPAR, LAI empirical algorithm was integrated into the code. This generation of the backup algorithm is driven using two pixel-wise independent variables, biome class and soil background (light, medium, and dark), and represents a refinement over the original scheme which was driven solely from the biome class variable.

3) ***D17 Development, with a Pre-V1 delivery due in the late May 1996 timeframe***: Further design refinements during this period were made to the MOD17 (PSN, NPP) algorithm, mainly in the area of the global surface climatology data handling. The plan remains to ingest a daily surface climatology represented by the Data Assimilation Office (DAO) processed National Meteorological Center (NMC) data stream at 2.5 degrees by 2.5 degrees spatial resolution. A separate pre-processing step is now defined that can be run either within or independently of the main MOD17 executable to perform the necessary temporal data reduction from the original 3-hour timestep a daily timestep for the key driving variables. These variables are: incident solar radiation, specific humidity, and near surface temperatures expressed as a daily minimum and maximum. The goal for the MOD17 Pre-V1 code delivery remains in the late-May 1996 timeframe, barring complications.

4) ***ience Data Development***: During this period, the NASA AVHRR Pathfinder 1 KM North American Continent 10-day dataset was ordered and received from the EROS Data Center (EDC) DAAC. This (72) tape sequence comprises the North American subset of the original global 1 KM AVHRR Pathfinder dataset. The MODIS assistant programmer/analyst is currently producing a set of monthly composites from these 10-day composites using custom compositing software (***avhrrmon***) produced at the University of Montana SCF. This project is designed to produce a set of 1 KM NDVI, visible and NIR reflectance, and surface temperature monthly images for use in further algorithm development and validation for our AM-1 platform MOD15 and MOD17 algorithm suite.

In addition, with the help of Robert Wolfe at GSFC, we established a set of (8) daily 1 KM MODIS Land MOD09 surface reflectance datasets formatted into spec-compliant HDF v.4.0 files. These data currently represent the canonical test data inputs used by a series of closely related MODIS Land algorithm groups (ours, Eric Vermotes, Alfredo Huetes, and others) for beta and pre-V1 algorithm test and integration. Each of the (8) datasets represents a 300x300 (1/16th tile) region over the Chesapeake Bay region. A detailed statistical characterization of this initial test dataset is being assembled to assist in cross-product validation and algorithm performance characterizations.

5) ***Staff Development***: An assistant MODIS programmer/analyst (Don Tillotson) was hired in January. Don has a background in computer science, and is helping with a

wide variety of software development related tasks. Current project include developing the set of function level unit-test codes for the MUM API, developing a ESDIS prolog extraction toolset for software documentation organization, and running the monthly compositing process for 1 KM AVHRR data.

6) ***SCF Compute Facility Development***: During this period, the first complement of RAID Level 0/3 fixed disk store (64G) was evaluated on-site, with plans to purchase this and an additional 64G of RAID Level 0/3 as soon as the approval process is complete. Additionally, a skeletal level of the SCF network services upgrade was implemented with the order for a CISCO Catlyst 5000 (C5K) intelligent switch and related network components. Our SCF network services goal is to attain an Asyncronous Transfer ATM (155Mbps) capability by December of 1996. The University of Montana campus network upgrade plan to help achieve this has been approved, and is slated to be in place by the end of September, 1996. This plan calls for a reworking of the entire UM network trunk with CISCO 7507 routers, to replace the older AGS routers now in place on the campus FDDI trunk.

7) ***Local SCF support software tool development***: Several new software tools were developed during this period, to assist in verifying the HDF input and output data for our MODIS Land algorithms. These include the ***hdftoraw*** application for extracting one or more Science Data Sets (SDS) from existing HDF files into binary image files, and the ***rawtohdf*** application, for loading one or more binary raw images into an HDF volume.

Meetings Attended:

January 1996	* On-site MODIS Software Development Meeting with Robert Wolfe, during which the prototype spatial aggregation MOD15 software (***laifp3***) was designed.
	*NCGIA Conference, Santa Fe, New Mexico. Co-hosted a large volume data repository workshop with Mike Sweet of the University of Montana School of Forestry and Ray Ford of the University of Montana Computer Science Department.
February 1996	* MODLAND-SDST Meeting, GSFC, to facilitate on-going coordination between the MODLAND team and the SDST.
April/May 1996	* MODIS Science Team Meeting, GSFC, attending the MODIS Programmers Forum April 30 prior to the formal Science Team Meeting.

On-Going Activities:

1) Preparations for a MOD17 Pre-V1 code delivery to SDST in the late May 1996 timeframe.

2) Preparations for a formal V1 MOD15 and MOD17 code delivery to include new EOSDIS/ESDIS metadata requirements in the late June 1996 timeframe.

3) Preparation of updated V1 HDF Product specifications for the MOD15 and MOD17 AM-1 products

4) Review of formal SDST documents: V1 Software Process Definition spreadsheet, V1 Process bubble charts, the SCF V1 Software Delivery Guide, and the V1 MODIS Software Development Standards and Guidelines.